

(19) World Intellectual Property Organization  
International Bureau



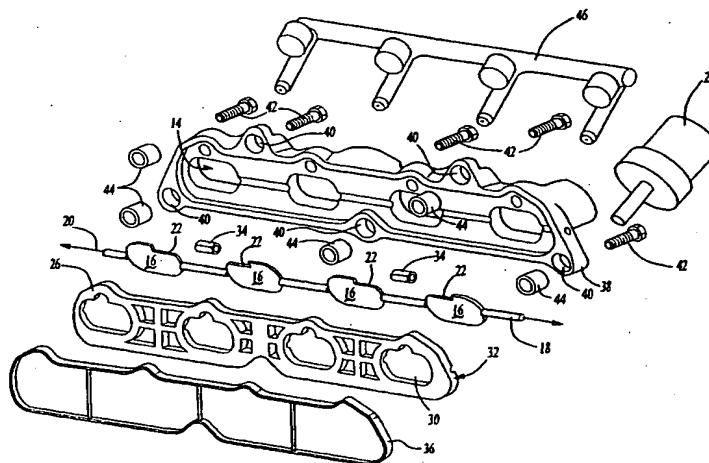
(43) International Publication Date  
25 May 2001 (25.05.2001)

PCT

(10) International Publication Number  
**WO 01/36796 A1**

- (51) International Patent Classification<sup>7</sup>: F02B 31/08, F02M 35/10 (72) Inventor: MURPHY, Kevin, Arthur; 39526 Salvatore, Sterling Heights, MI 48313 (US).
- (21) International Application Number: PCT/CA00/01326 (74) Agent: MACRAE & CO.; P.O. Box 806, Station B, Ottawa, Ontario K1P 5T4 (CA).
- (22) International Filing Date: 7 November 2000 (07.11.2000) (81) Designated State (national): JP.
- (25) Filing Language: English (84) Designated States (regional): European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR).
- (26) Publication Language: English
- (30) Priority Data: 60/165,155 12 November 1999 (12.11.1999) US  
Published:  
— With international search report.
- (71) Applicant: SIEMENS CANADA LIMITED [CA/CA]; 16 Industrial Park Road, Tilbury, Ontario NOP 2L0 (CA).  
For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: INTEGRATED SWIRL CONTROL VALVE



(57) Abstract: The subject invention is an intake manifold with a swirl control valve assembly mounted to an internal combustion engine. The intake manifold assembly includes a plurality of air intake passages through which air flows to the combustion chambers of the engine. The air flow control valve assembly is mounted within the intake manifold between the intake manifold and the engine. The air flow control valve assembly includes a plurality of valve plates to direct air flowing through the air intake passages. The valve plates are disposed within the air intake passages and are mounted to a common shaft for rotation about an axis. The valve plates rotate between an open position and a closed position. Each of the valve plates has an opening that allows the flow of air through the air intake valve when the valve plate is in the closed position. The opening is configured in such a manner to direct the flow of air through the air intake passage. The size and position of the opening in each of the valve plates is arranged and configured to create a predetermined flow of the air into the combustion chamber to promote efficient combustion of the air fuel.

WO 01/36796 A1

## INTERGRATED SWIRL CONTROL VALVE

### BACKGROUND OF THE INVENTION

This application discloses an air intake manifold with an air flow control valve  
5 assembly.

Typically, air enters an intake manifold through a throttle body. Typically, the throttle body includes one throttle valve that regulates the intake of air into the intake manifold. Once air is in the intake manifold, the air flows through a plurality of air passages or runners. Only the shapes of internal surfaces of the intake manifold control  
10 air flowing through the air passages. Typically, air mixes with fuel and is injected into a combustion chamber of the engine. The specific way in which air flows through an intake manifold and into the combustion chamber directly affects how efficient the engine will run. For these reasons the interior surfaces of the intake manifold are designed to promote efficient airflow through the intake manifold and to each individual  
15 cylinder. However, differing engine operating conditions may require different airflow characteristics, so a balance of air flow requirements for each engine speed is made, thereby, sacrificing optimal performance at all engine operating conditions.

Further, emission standards for vehicles are becoming increasingly demanding. One of the more demanding of the emission standards pertains to the initial start up of  
20 the engine in a cold environment. The engine upon initial start up and idle conditions typically exhibits the most inefficient and incomplete combustion of the air fuel mixture. Incomplete combustion of the air fuel mixture increases the amount of measurable emissions from a vehicle.

For these reasons it is desirable and necessary to provide a device that can direct  
25 and condition the flow of air through an intake manifold and into the combustion chamber to account for variable engine operations settings and to promote efficient combustion of the air fuel mixture at low engine operating conditions.

### SUMMARY OF THE INVENTION

30 The subject invention is an intake manifold assembly with an integral air flow control valve assembly.

The intake manifold assembly includes a plurality of air intake passages through which air flows to combustion chambers of the engine. The air flow control valve assembly is mounted within the intake manifold between the intake manifold and the engine. The air flow control valve assembly includes a plurality of valve plates to direct  
5 air flowing through each of the air intake passages. The valve plates are disposed within the air intake passages and are mounted to a common shaft for rotation about an axis. An actuator controlled by an engine electronic control unit rotates the shaft and the valve plates rotate between an open position and a closed position. Each of the valve plates includes an opening that allows the flow of air through the air intake valve  
10 when the valve plate is in the closed position. The opening is configured in such a manner to direct the flow of air through the air intake passage. The directed air flow promotes efficient combustion of the air fuel mixture at low engine speeds. Further, the valve plates are rotated to the open position at higher engine speeds that require different air flow direction.

15 The subject invention overcomes the problems of prior art intake manifolds and promotes efficient combustion by providing a plurality of valve plates within the intake manifold to direct the flow of air into each combustion chamber. Further, the subject invention provides for the variable positioning of the valve plates to accommodate the air directing and conditioning requirements at various engine operating conditions.

20

#### BRIEF DESCRIPTION OF THE DRAWINGS

The various features and advantages of this invention will become apparent to those skilled in the art from the following detailed description of the currently preferred embodiment. The drawings that accompany the detailed description can be briefly  
25 described as follows:

Figure 1 is a perspective view of an intake manifold with an integral control valve;

Figure 2 is an exploded view of the intake manifold and integral flow control valve; and

30 Figure 3 is cutaway view of a valve plate disposed in the intake manifold.

### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the Figures, wherein like numerals indicate like or corresponding parts throughout the several views, the subject invention is an intake manifold assembly 10 with an air flow control valve assembly 12 mounted to an internal combustion engine. Referring to Figure 1, the intake manifold assembly 10 includes a plurality of air intake passages 14 through which air flows to combustion chambers of the engine. The air flow control valve assembly 12 is mounted within the intake manifold assembly 10 and between the intake manifold 10 and the engine. The air flow control valve assembly 12 includes a plurality of valve plates 16 to direct air flowing through the air intake passages 14. The valve plates 16 are disposed within the air intake passages 14 and are mounted to a common shaft 18 for rotation about an axis 20. The valve plates 16 rotate between an open position and a closed position.

Referring to Figure 2, each of the valve plates 16 has an opening 22 that allows the flow of air through the air intake passages 14 when the valve plates 16 are in the closed position. The opening 22 is configured in such a manner to direct the flow of air through the air intake passage 14. Specifically, the size and position of the opening 22 in each of the valve plates 16 is arranged and configured to create a predetermined flow of the air into the combustion chamber. The predetermined flow promotes efficient combustion of the air fuel mixture at low engine speeds. The preferred embodiment of the subject invention includes an approximately rectangular opening disposed at in the valve plate to create the proper airflow required for each combustion chamber.

Referring to Figure 3, the valve plates are fixed to the shaft and rotate between an open and closed position. The openings 22 are disposed relative to each individual air intake passage 14. Specifically, as shown the openings 22 are generally rectangular shaped and disposed at an upper corner of each valve plate 16. The shape of the opening is intended to create an airflow that promotes efficient combustion in the combustion chamber and is not limited to rectangular shape of the subject invention. One knowledgeable in the art will recognize that the opening 22 may be of any shape or position on the valve plate 16 that promotes the efficient combustion of the fuel air mixture.

The shaft 18 is driven for rotation about the axis 20 by an actuator 24. An

engine electronic control unit (not shown) controls the actuator 24 to rotate the shaft 18 and thereby open the valve plates 16 as required for the desired engine operating condition.

The shaft 18 is held in place for rotation about the axis 20 by a retainer plate 26. 5 The retainer plate 26 and shaft 18 fit into a recess 28 in the intake manifold 10. Openings 30 in the retainer plate 26 conforms to the contours of the air intake passages 14 of the intake manifold 10 and assist in directing air flow through the intake manifold 10 and into the combustion chamber. In the preferred embodiment, a periphery 32 of the retainer plate 26 is the same shape as the intake manifold 10. Specifically, the 10 retainer plate 26 is shaped to fit into the recess 28 fabricated into the intake manifold assembly 10. The shaft 18 is secured for rotation about the axis 20 between the retainer plate 26 and the intake manifold 10. Linear bearings 34 provide for the mounting and rotation of the shaft 18 trapped between the retainer plate 26 and the intake manifold 10.

A seal 36 is disposed between the intake manifold 10 and the engine. The seal 15 36 ensures that air flow through each of the individual air intake passages 14 is not mixed with air flow from any of the other air intake passages 14. The seal 36 also prevents air flow from escaping to atmosphere from any of the air intake passages 14.

The air intake manifold includes a flange 38 with having a plurality of flange openings 40 for fasteners 42 used to attach the intake manifold 10 to the engine. In the 20 preferred embodiment the intake manifold 10 is fabricated from a plastic material. Inserts 44 are disposed within each of the flange openings 40 to prevent the fasteners 42 from being over tightened to cause damage to the intake manifold 10.

In the preferred embodiment shown in Figure 3, a fuel rail 46 is attached to the intake manifold 10 to provide fuel to each of the combustion chambers. The fuel rail is 25 just one example of how fuel may be introduced into the intake manifold 10. It is understood that any device known those knowledgeable in the art may be used with the subject invention to introduce fuel into the combustion chamber.

The foregoing description is exemplary and not just a material specification. The invention has been described in an illustrative manner, and should be understood 30 that the terminology used is intended to be in the nature of words of description rather than of limitation. Many modifications and variations of the present invention are

possible in light of the above teachings. The preferred embodiments of this invention have been disclosed, however, one of ordinary skill in the art would recognize that certain modifications are within the scope of this invention. It is understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described. For that reason the following claims should be studied to  
5 determine the true scope and content of this invention.

CLAIMS

1. An intake manifold assembly mounted to an internal combustion engine comprising;
- 5 a plurality of air intake passages;  
a valve plate disposed in each of said air intake passages for directing airflow through said intake passages;  
a shaft fixed to rotate said valve plates between an open and closed position;
- 10 said valve plates having an opening such that in said closed position said opening directs the flow of air through said intake passage.
2. The assembly of claim 1, wherein said opening of said valve plate is shaped to preferentially direct airflow into said engine.
- 15 3. The assembly of claim 2, further including a retainer plate attached to said intake manifold to shape airflow into the engine.
4. The assembly of claim 4, where said retainer plate defines the contour of said air intake passages.
- 20 5. The assembly of claim 1, further including an actuator fixed to rotate said shaft.
- 25 6. The assembly as in claims 1, further including a seal attached to said retainer plate to isolate air intake through each of said air intake passages.
7. The assembly of claim 1, further including a bearing attached to support said shaft in said intake manifold.
- 30

8. The assembly of claim 1, wherein said intake manifold is fabricated from plastic and includes an attachment flange and said attachment flange includes a plurality of openings.

5 9. The assembly of claim 6, further including a plurality of inserts disposed within said opening of said attachment flange and a plurality of fasteners extending through said inserts to secure said intake manifold to the engine.

10 10. An swirl control valve assembly for an intake manifold mounted to an internal combustion engine comprising;

a plurality of air intake passages;

a plurality of valve plates disposed within each of said air intake passages to direct airflow through said intake passages;

15 a shaft fixed to rotate said valve plates between an open and closed position;

a retainer plate to shape airflow through said air intake passages and to secure said shaft to said intake manifold; and

said valve plates having an opening such that in said closed position said opening directs the flow of air through said air intake passage.

20 11. The assembly of claim 10, further including a flange, said flange having a recess to receive said retainer and said valve plates.

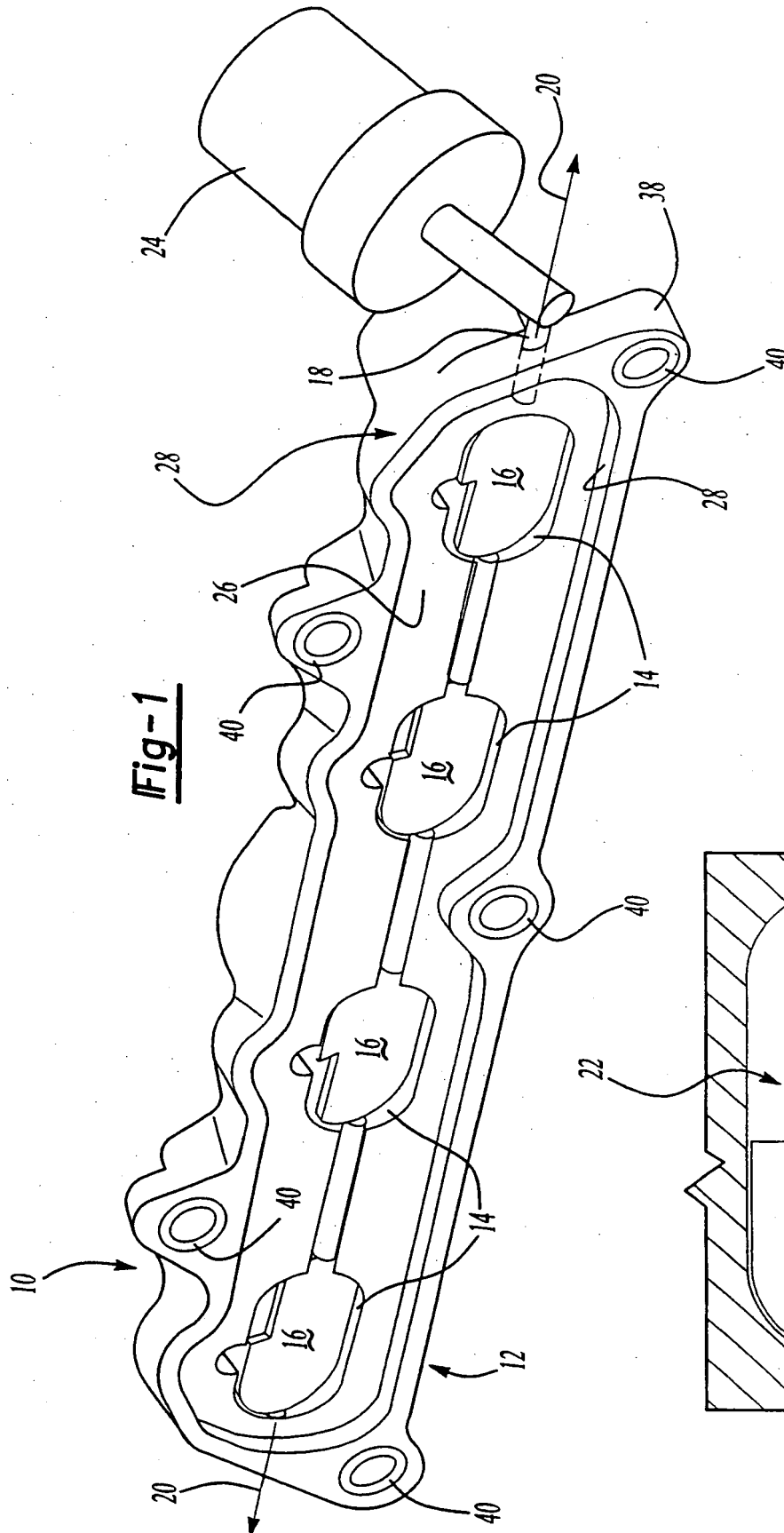
25 12. The assembly of claim 10, further including a seal disposed between said intake manifold and the engine, said seal isolates air flow through said air intake passages from each other.

30 13. The assembly of claim 10, wherein said intake manifold is fabricated from plastic.

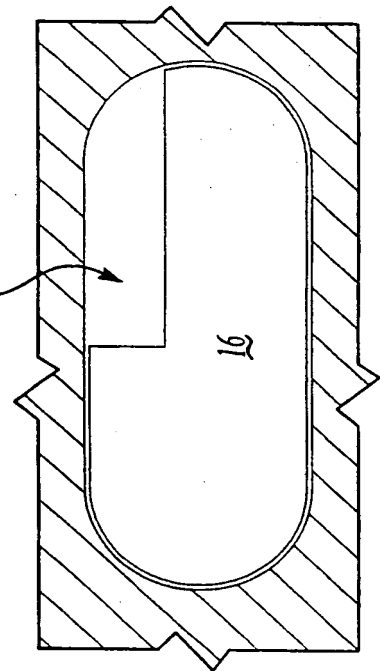


14. The assembly of claim 13, further including an attachment flange having a plurality of openings, an insert within each of said openings, and a fastener extending through each of said openings to secure said intake manifold to the engine.

1/2

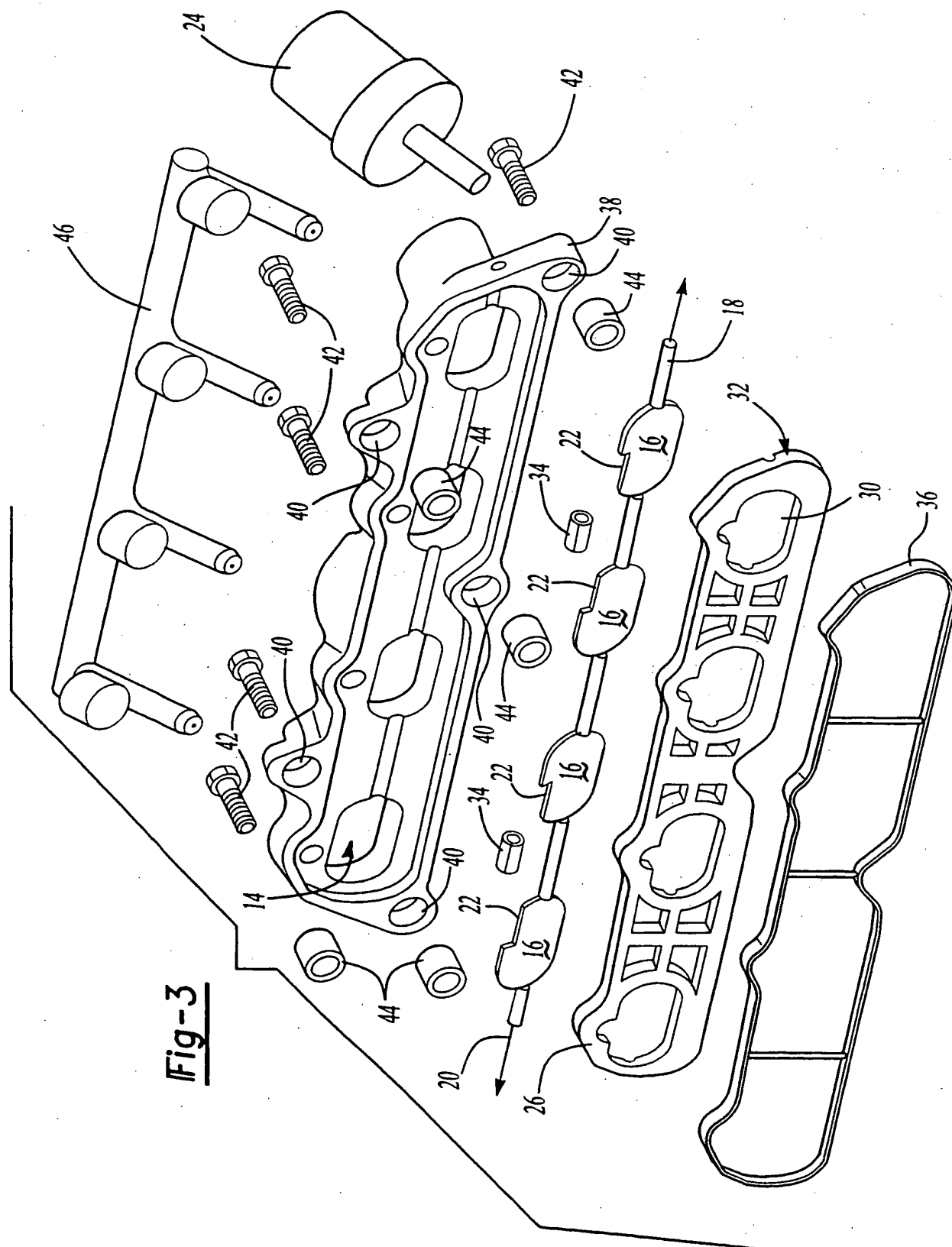


**Fig-1**



**Fig-2**

SUBSTITUTE SHEET (RULE 26)



**SUBSTITUTE SHEET (RULE 26)**

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/CA 00/01326

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 F02B31/08 F02M35/10

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 F02B F02M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 979 401 A (HICKEY JOHN CURTIS) 9 November 1999 (1999-11-09)	1-7, 10-12
Y	abstract; claims 1,10; figures 1,2,11  column 2, line 58 -column 3, line 35 column 4, line 26 - line 28 ---	8,9,13, 14
Y	WO 99 10658 A (GEIGER MICHAEL; JESSBERGER THOMAS; MAIER STEFAN (DE); MANN & HUMMEL) 4 March 1999 (1999-03-04)	8,9,13, 14
A	abstract; claims 1-3,5; figures 1,4-9 page 3, paragraph 4 page 5, paragraph 2 - paragraph 3 page 6, paragraph 3 - paragraph 4 --- -/--	1,10



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

\* Special categories of cited documents:

\*A\* document defining the general state of the art which is not considered to be of particular relevance

\*E\* earlier document but published on or after the international filing date

\*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

\*O\* document referring to an oral disclosure, use, exhibition or other means

\*P\* document published prior to the international filing date but later than the priority date claimed

\*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

\*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

\*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

\*G\* document member of the same patent family

Date of the actual completion of the international search

19 February 2001

Date of mailing of the international search report

23/02/2001

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Döring, M

# INTERNATIONAL SEARCH REPORT

Int. Application No

PCT/CA 00/01326

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	EP 0 711 906 A (YAMAHA HATSUDOKI KABUSHIKI KAISHA) 15 May 1996 (1996-05-15) claims 1,2,14,15; figures 1,12  column 5, line 5 -column 6, line 46 column 10, line 55 -column 11, line 51 ----	1-7,10, 12 8,9,11, 13,14
X A	DE 44 45 777 A (NISSAN MOTOR CO LTD) 29 June 1995 (1995-06-29) abstract; figures 1-3 page 3, line 49 -page 4, line 7 ----	1,2,5-7 3,4,8-14
A	US 5 696 318 A (ERNST VOLKER; LEIPELT RUDOLF) <sup>8</sup> 9 December 1997 (1997-12-09) abstract; figures 1-3 column 3, line 6 -column 4, line 4 -----	1-14

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/CA 00/01326

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5979401 A	09-11-1999	DE 19934509 A GB 2340544 A	17-02-2000 23-02-2000
WO 9910658 A	04-03-1999	EP 1038110 A ZA 9807697 A	27-09-2000 25-02-1999
EP 0711906 A	15-05-1996	JP 8121179 A DE 69516482 D DE 69516482 T US 5636613 A	14-05-1996 31-05-2000 07-09-2000 10-06-1997
DE 4445777 A	29-06-1995	JP 7180559 A KR 167381 B	18-07-1995 15-12-1998
US 5696318 A	09-12-1997	DE 19504382 A BR 9600558 A CA 2169199 A CN 1134506 A CZ 9600348 A DE 59600327 D EP 0726388 A JP 8240123 A ZA 9600983 A	14-08-1996 30-12-1997 11-08-1996 30-10-1996 14-08-1996 20-08-1998 14-08-1996 17-09-1996 29-08-1996